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$x = 0$ gives δ for mid-span

$$EI\delta = C,$$

and since $\delta = 0$ for $x = a$ we have at mid-span

$$EI\delta = -\tfrac{1}{24}ba^4 + \tfrac{1}{360}pa^6 + \tfrac{1}{4}ba^4 - \tfrac{1}{24}pa^6.$$

If the parabola passes through the ends of the beam, as it is evidently intended that it should in the exercise, we have $p = b/a^2$. Whence, as required, $EI\delta = \tfrac{61}{360}a^4b$. [*W. H. Echols.*]

EXERCISES.

310

SOLVE for $x_1 \colon x_2 \colon x_3$ the continued equality

$$(x_2 + x_3)(x_2 - x_3)^2 = (x_3 + x_1)(x_3 - x_1)^2 = (x_1 + x_2)(x_1 - x_2)^2.$$

[*E. H. Moore.*]

311

TO FIND four biquadrate numbers whose sum is a square number.

[*Artemas Martin.*]

312*

GIVEN

$$u = x\sin x + \cos x,$$
$$v = \sin x - x\cos x;$$

to compute

$$\int\frac{x^2dx}{u^2}, \qquad \int\frac{x^2dx}{v^2}, \qquad \int\frac{bx^2dx}{(au + bv)^2}.$$

[*C. Hermite.*]

313

GIVEN three points and three straight lines in a plane, the determinant of the nine perpendiculars from the points to the lines is equal to twice the product of the areas of the triangles formed by the points and by the lines, divided by the radius of the circle circumscribing the latter. [*W. W. Johnson.*]

314

A CYLINDER, diameter $2b$, intersects a sphere, diameter $2a$, the surface of the cylinder passing through the centre of the sphere. Required the part of the volume of the sphere contained by the cylinder. [*Artemas Martin.*]

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* Suggested by *W. W. Beman.* Hermite (Cours d'Analyse, 1873, p. 260) says: "On n'a aucun procedé pour trouver directement."

315

A MAN runs a race starting with velocity v, the direction of the wind appearing to him to make an angle α with his course. It then appears uniformly to veer round through an angle α during the race. The wind blows uniformly throughout and at right angles to his course. Show that if t be the time of the race, the length of the course is $vt\,\frac{\tan\alpha}{\alpha}\log(2\cos\alpha)$.

[*William Hoover.*]

316*

THE distance between the heels of a man's feet is $2b$, and the length of each foot is a. As the body sways, the vertical through the centre of gravity must always pass through the area contained by the feet. The toes should therefore be turned out at such an angle that the area contained by the feet is a maximum. Show (1) that a circle can be described about the feet with its centre on the straight line joining the toes, and (2) that the diameter of the circle is $b + (2a^2 + b^2)^{\frac{1}{2}}$. [*E. J. Routh.*]

317

THE arc of a lemniscate is shown in works on the Calculus to be equivalent to the arc of a certain ellipse. Show that the double point on the lemniscate corresponds with Fagnani's point on the ellipse.

[*W. B. Richards.*]

318

D is any point in the base BC of a triangle ABC. O_1 and O_2 are the centres of the inscribed circles of BAD and CAD. Then, if $\triangle =$ area ABC,

(1) Area $AO_1O_2 = \frac{\triangle r}{a}\operatorname{cosec} ADC$;

(2) If AD bisects A, $AO_1O_2 = \frac{\triangle r}{b+c}\operatorname{cosec}\frac{1}{2}A$;

(3) If AD is the altitude, $AO_1O_2 = \frac{\triangle r}{a}$.

[*T. U. Taylor.*]

319

To construct a triangle $ABC\,(BC > AB > CA)$, the angle A being known, and having given

$$AB + BC = m, \qquad AB + CA = n;$$

or

$$BC - AB = p, \qquad AB - CA = q.$$

[*J. E. Hendricks.*]

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* Suggested by *A. Hall.*